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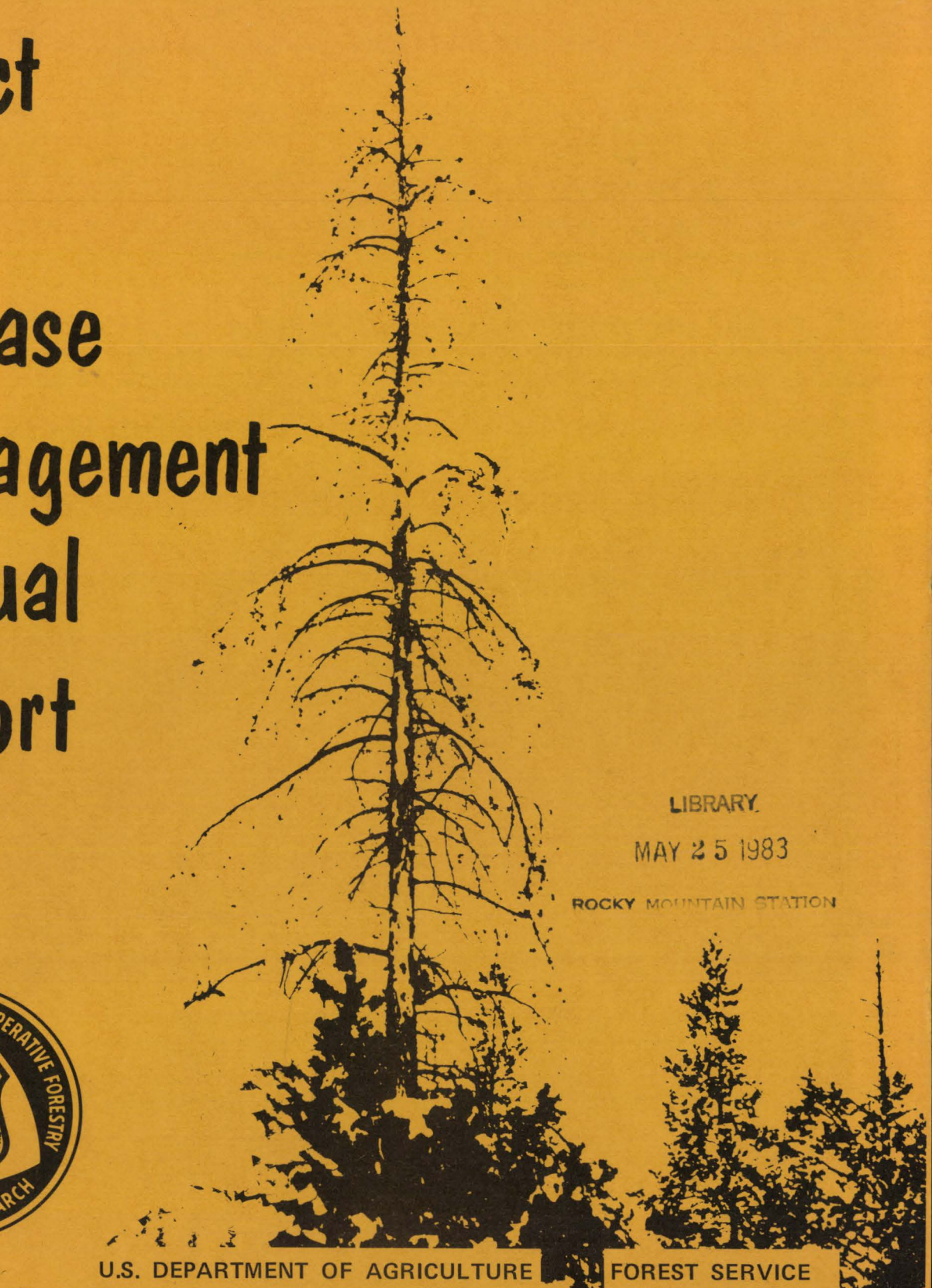
Forest Insect and Disease Management Annual Report

Rocky Mountain Region



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FOREST INSECT AND DISEASE MANAGEMENT

ANNUAL REPORT

ROCKY MOUNTAIN REGION

1976

by

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and

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June 1977

Forest Insect and Disease Management
State and Private Forestry
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TABLE OF CONTENTS

	Page
ACKNOWLEDGMENT	1
INTRODUCTION	2
FOREST INSECT AND DISEASE MANAGEMENT - ORGANIZATION CHART	3
INSECT AND DISEASE CONDITIONS IN BRIEF	4
STATUS OF INSECTS	6
Bark Beetles	6
Defoliators	8
Shelterbelt Insects	10
Other Insects of Importance	11
STATUS OF DISEASES	14
Dwarf Mistletoes	14
Stem Diseases	15
Vascular Wilts	17
Root Diseases	22
Weather Damage	23
Nursery Problems	24
Miscellaneous Studies	25

TABLE OF CONTENTS
(continued)

	Page
APPENDIX	27
Illustrations	28
USDA, Forest Service, Detection Report, Forest Insect and Disease Damage - R-2 5200-2	46
Biological Evaluations Completed During 1976 by the Forest Insect and Disease Management Staff (R-2)	48
Technical Reports Completed During 1976 by the Forest Insect and Disease Management Staff (R-2)	51
Index of Insects	52
Index of Diseases	55
Regional Map - Distribution of Selected Forest Insects and Diseases in Region 2 - 1976	
Regional Map - Distribution of Dutch Elm Disease - 1976	

ILLUSTRATIONS

Fig. 1 Western spruce budworm

Fig. 2 Zimmerman pine moth

Fig. 3 Dwarf mistletoe and mountain pine beetle

Fig. 4 Limber pine dwarf mistletoe
Comandra blister rust
Diplodia tip blight

Fig. 5 Oak wilt

Fig. 6 Shoestring root rot of juniper

Fig. 7 Weather damage
Seedling loss at Mt. Sopris

Fig. 8 Herbicide tests at Mt. Sopris

Fig. 9 Tumors of unknown cause on lodgepole pine

ACKNOWLEDGMENT

Appreciation is extended to all the Federal and State personnel who contributed the information presented in this second annual report of forest pest conditions in Region Two. The following organizations contributed information for this report: Colorado State Forest Service, Colorado State University, South Dakota State Division of Forestry, South Dakota State University Cooperative Extension Service, Nebraska State and Extension Forestry, University of Nebraska Institute of Agriculture and Natural Resources, Wyoming State Forestry Division, University of Wyoming Agricultural Extension Service, Kansas State and Extension Forestry, and Rocky Mountain Forest and Range Experiment Station.

INTRODUCTION

Forest Insect and Disease Management (FIDM) is directed by the Forest Pest Control Act of 1947 to be responsible, on lands administered by the Forest Service, for prevention, detection, evaluation and suppression of forest insects and diseases. On lands administered by other Federal agencies FIDM is responsible for detection surveys and biological evaluations and for providing technical advice to land managers in forest insect and disease prevention and suppression. On non-Federal land, state agencies and private landowners are responsible for forest insect and disease control. A number of Federal forest management programs are available to assist state and private landowners, both financially and technically. These programs are administered through cooperative agreements with the states.

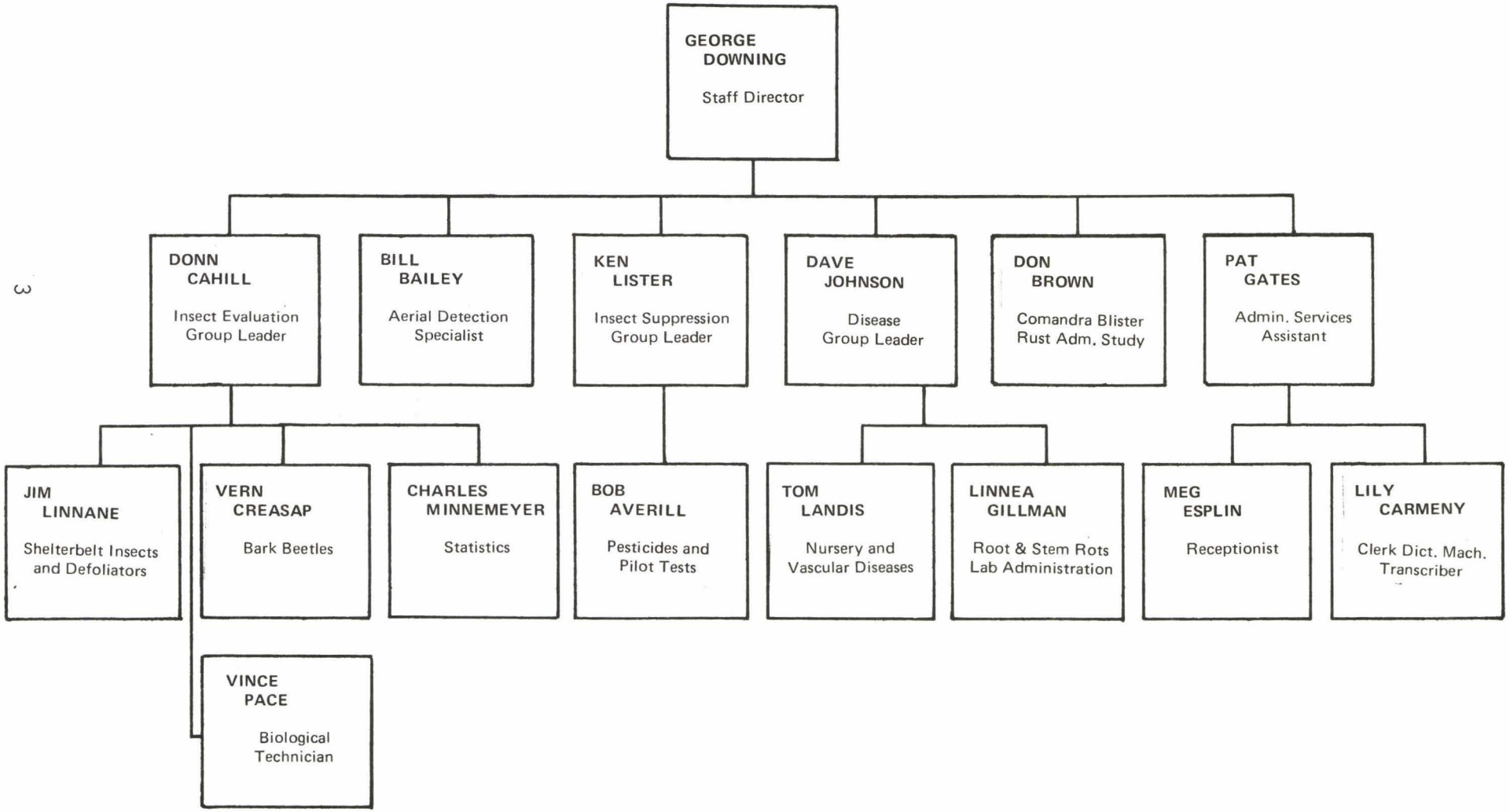
Ground and aerial surveys throughout the Region in 1976 were used to record forest insect and disease infestations. Some surveys were in cooperation with the states of Colorado, Wyoming, South Dakota, Nebraska and Kansas. In the Appendix, two maps depict the distribution of several of the major insects and diseases in the Region.

A detection reporting form (R-2 5200-2, see Appendix) is available from the Forest Service USDA. Some states have similar forms. FIDM supports the use of these forms by all forest resource land managers since a significant reduction of insect and disease caused losses can be realized by early reporting and prompt initiation of prevention or suppression measures.

Additional information on specific insect and disease pests may be requested from the FIDM Staff located at the Regional Office.

FOREST INSECT AND DISEASE MANAGEMENT

ORGANIZATIONAL CHART



CONDITIONS IN BRIEF

Mortality of ponderosa pine, due to large populations of mountain pine beetle continued in the Black Hills of South Dakota and Wyoming and along the Front Range of Colorado. Beetle populations are predicted to remain high in both areas. Populations have increased along the eastern slope of the Bighorn Mountains in Wyoming.

Mountain pine beetle populations showed a decline in lodgepole pine in the Medicine Bow National Forest and the Middle Park area of Colorado and are predicted to remain high around Atlantic City, Wyoming, and in the southern part of the Shoshone National Forest.

Western spruce budworm activity was more widespread in Colorado and was reported in Wyoming for the first time since 1962. A pilot test using acephate against western spruce budworm provided excellent foliage protection on Douglas-fir trees.

A large infestation of sawfly was found in ponderosa pine on the Rosebud Indian Reservation in South Dakota. Elm leaf beetle, Zimmerman pine moth, pitch-nodule moth, fall webworm and other insects continued to damage plantations and shelterbelts in the Plains States. Damage to shade trees by several insects was reported as light to moderate in urban areas.

A study was conducted to measure the impact of Comandra blister rust on potential yield of pole-size and smaller lodgepole pine. A relatively low level of damage and mortality was found, and infections less than ten years old were infrequent. A preliminary survey of root diseases of managed conifer stands indicated that shoestring root rot was the most serious disease, resulting in poor stocking in several areas. This root disease was also found on Rocky Mountain juniper, a new host in the United States. Diplodia tip blight was detected in 38 counties surveyed in the eastern third of Nebraska.

Dutch elm disease was detected in two new counties in South Dakota and oak wilt found in two additional counties in Kansas. A severe spring frost caused widespread foliage damage to aspen and conifers in most mountainous locations. Seedling losses at Mt. Sopris Tree Nursery were primarily caused by damping-off fungi and bird predation. Several new preemergence and contact herbicides tested at the nursery showed promise for weed control in

seedbeds. Studies were continued on inoculation of containerized ponderosa pine with ectomycorrhizal fungi. Tumors of unknown cause infected overmature lodgepole pine in 300 to 400 acres in Wyoming.

STATUS OF INSECTS

BARK BEETLES

MOUNTAIN PINE BEETLE: *Dendroctonus ponderosae*
Distribution Map

Salvage logging of beetle-infested trees and an increase in timber sales to improve stand conditions continues in the Black Hills National Forest. These procedures will make these stands less susceptible to attack by mountain pine beetle and protect forest resource values. After an aerial survey to estimate the number of 1975-infested ponderosa pine and ground cruises to determine the ratio of 1975- to 1976-infested trees, it was estimated that approximately 611,000 trees became infested during 1976.

Suppression projects conducted by the South Dakota Division of Forestry (1) felled, piled and burned, (2) felled, bucked and drenched with ethylene dibromide, and (3) salvage logged 202,944 infested trees. The Wyoming Forestry Division treated 547 infested trees and removed 11,857 infested trees. Salvage logging in the Black Hills National Forest removed 247,409 infested trees.

Numerous overstocked, mature and dwarf mistletoe-infected trees on very rugged terrain of mixed ownership along the Front Range of Colorado continue to ensure epidemic levels of mountain pine beetle. A cooperative mountain pine beetle project conducted by the Colorado State Forest Service accomplished treatment of 85,945 infested trees. Three methods of treatment were used: (1) fell, buck and drench with ethylene dibromide (2) fumigate by stacking, drenching and covering with plastic sheeting and (3) salvage logging. Nearly all treatment was conducted in "Designated Control Areas" (DCA's), where private landowners organized for treating mountain pine beetle infested trees within a geographical area designated by the Colorado State Forest Service.

The Arapaho and Roosevelt National Forests removed 31,879 infested trees from Forest Service land included within six DCA's and from timber sale areas. On the Pike and San Isabel National Forests 8,689 infested trees were salvaged in timber sales.

In Wyoming, mountain pine beetle populations in ponderosa pine increased along the eastern slope of the Bighorn Mountains on lands of all ownerships. Beetle populations in the Pine Hills, near Midwest, Wyoming, remained at a high level. Suppression in these areas of infestation was not feasible primarily because of limited access.

Mountain pine beetle infestations in lodgepole pine in the Middle Park region of Colorado and in the Medicine Bow National Forest in Wyoming have decreased. Samples of the infestations showed the populations were down 50 percent from 1975.

The large infestation of mountain pine beetle increased in lodgepole pine near Atlantic City and South Pass, Wyoming, on the southern portion of the Shoshone National Forest, on National Resource Lands, and private lands adjacent to the National Forest. A cooperative timber sale to salvage infested and beetle killed trees was coordinated by the Forest Service, the Bureau of Land Management and private landowners through the State Forester, Wyoming Forestry Division, to remove infested trees from 5,700 acres over a period of 6 years. This is the first cooperative agreement of this type in Wyoming. Three hundred thirty trees were removed from private lands. With the beetle population expanding beyond the present sale boundary, plans were being made for additional timber sales to reduce the loss of green merchantable timber.

The suppression data reported by the States and Forest Service units extends from July 1, 1975 to September 30, 1976. The additional 3 months reflect the changeover to the new fiscal year.

SPRUCE BEETLE: *Dendroctonus rufipennis*

The principal areas of spruce beetle activity were near timber sales and did not present any serious threats to surrounding spruce stands. Ski areas, particularly those in which new runs have been cut through spruce stands, were surveyed but beetles were not a major problem. The Rio Grande National Forest removed 190 infested spruce trees by contract salvage logging to protect a volume of 19 MBF.

DOUGLAS-FIR BEETLE: *Dendroctonus pseudotsugae*

In recent years, this insect caused heavy mortality of commercial-size Douglas-fir in Colorado and Wyoming. No large areas of current beetle activity were found. Small groups of trees were reported on steep slopes in the Bighorn National Forest, but these infestations, or ground examination, appeared to be static to decreasing.

IPS BEETLES: *Ips pini*

These insects were found in ponderosa pine on the San Juan National Forest. *Ips pini* was reported on jack pine in Garfield, Dawes and Sheridan counties of Nebraska. *Ips* spp. were also found on ponderosa pine in Coal Creek Canyon, Colorado, and in several locations in Boulder County and Estes Park, Colorado, where tree deaths due to this agent were found to be increasing. *Ips* spp. have been found in the tops of mountain pine beetle-killed ponderosa pines all along the Front Range.

DEFOLIATORS

WESTERN SPRUCE BUDWORM: *Choristoneura occidentalis*
Distribution Map, Fig. 1

Defoliation of Douglas-fir and true fir by western spruce budworm was generally light to moderate in 1976, although more acres of defoliation were reported in Colorado than in 1975 and during aerial detection missions defoliation was reported in Wyoming for the first time since 1962. Some Christmas tree areas were damaged beyond use for the year on the Arapaho, Roosevelt, Pike, and San Isabel National Forests due to moderate and heavy defoliation. There were 497,000 acres infested in Colorado and 20,500 acres infested in Wyoming.

Most parasites known to attack spruce budworm in Colorado were recovered during surveys conducted to determine parasitism within spruce budworm populations. Parasitism ranged from 8 to 51 percent of the larvae collected. Higher levels of parasitism were associated with the older infestations. *Phaeogenes hariolus*, *Coccygomimus pedalis*, and *Ceromasia* spp. (probably *auricauda*) were more common than *Glypta fumiferanae* and *Apanteles fumiferanae* in some areas of the San Juan, Pike, and San Isabel National Forests.

Small scale pilot tests were conducted with western spruce budworm in a continuation of a program to develop protective sprays for ornamentals and Christmas trees. Acephate was applied at 4 lb a.i./100 gal. water to young larvae just burrowing into expanding buds. Ninety-seven percent of the new foliage was saved while 98 percent of the larval population was killed. Lethal residues of acephate were present about 2 weeks after treatment. On half of the treated plots, a second application of 2 lb a.i. 10 days later did not give a significant increase in foliage protection or larval mortality. Sodium fluoraluminate applied to budworm-infested Douglas-fir at 2 lb a.i./100 gal. water resulted in 95 percent mortality of 4th and 5th instar larvae.

DOUGLAS-FIR TUSSOCK MOTH: *Orgyia pseudotsugata*

This insect continued to be a problem on ornamental spruce in the Denver and Colorado Springs areas. The average number of eggs per egg mass was 188, larval emergence averaged 9 percent and emergence of the egg parasite *Telenomus californicus* averaged 10 percent. Parasitism by *T. californicus* ranged from 4 to 90 percent.

TENT CATERPILLARS: *Malacosoma californicum*, *M. incurvum discoloratum*, *M. disstria*, and *M. americanum*

These insects were common throughout the Front Range. Roadside surveys in the Boulder Ranger District, Roosevelt National Forest indicated a decline in tent density from last year. Two species were recovered this year; *Malacosoma californicum*, and *M. incurvum discoloratum*. Parasite emergence from laboratory-reared colonies indicated that *Rogas* spp. and *Bracon* spp. were common in

Pike and San Isabel National Forests collections and a *Hyposoter* sp. was common in Arapaho and Roosevelt National Forests collections. An unidentified tachinid fly was rare in all collections. Overall, parasitism was low. *Malacosoma disstria* and *M. americanum* were reported in South Dakota. *Malacosoma americanum* was most severe in game production areas and mortality of plum and chokecherry was observed in these areas.

WHITE FIR NEEDLE MINER: *Epinotia meritana*

The infestation of white fir needle miner remained at severe levels near LaVeta Pass in Colorado. New areas of infestation were found on the Blanco Trinchera lands west of LaVeta Pass. Total area of infestation was about 8500 acres, an increase of 1500 acres over 1975.

SHELTERBELT INSECTS

ZIMMERMAN PINE MOTH: *Dioryctria zimmermani*
Distribution Map, Fig. 2

Extensive damage was done to ornamental pines and shelterbelt pines where infestations were found in Blaine, Box Butte, Brown, Chase, Cherry, Custer, Dawes, Garfield, Grant, Hayes, Holt, Hooker, Keya Paha, Lincoln, Logan, Loup, Perkins, Rock, Thomas, Valley, and Wheeler counties of Nebraska.

SAWFLIES: *Neodiprion fulviceps*
Distribution Map

An infestation of approximately 1500 acres in ponderosa pine was found on the Rosebud Indian Reservation in South Dakota. Laboratory rearing of larvae and cocoons collected in the field produced few parasites and a low emergence of adults from cocoons.

Infestations of *N. fulviceps* complex were reported in Keith and Banner counties of Nebraska. The infestations were under five acres in size. Two infestations of this sawfly were reported on the plains east of Colorado Springs, Colorado. One area was two acres and the other was five acres.

ELM LEAF BEETLE: *Pyrrhalta luteola*

Continuing moderate to heavy defoliation was observed on American and Siberian elms throughout the region in urban areas and in shelterbelts of the Plains states.

GRASSHOPPERS: *Melanoplus* sp. and others.

Populations, although not as severe as originally predicted, did cause light to moderate damage in some areas. Defoliation in one shelterbelt on the Reservoir Forestry project in South Dakota was estimated at 36 percent. This and other grasshopper damage occurred on young trees up to 10 to 12 feet tall.

Grasshoppers damage was also noted in the Huron area, but defoliation was less than 10 percent.

OTHER INSECTS OF IMPORTANCE

IN COLORADO:

Ponderosa pine in Black Forest showed were light infestations of pine needle miner, *Coleotechnites* sp. The infestations on ponderosa pine near Boulder have spread and become more intensive. Sugar pine tortrix, *Choristoneura lambertiana ponderosana*, was found to be increasing along the Front Range of Colorado, particularly in the Poudre River Canyon, Big Thompson River Canyon, St. Vrain River and Genesee Mountain area. Another light infestation was found along the Mancos River in the San Juan National

Forest. Pine butterfly, *Neophasia menapia*, was found increasing to moderate and heavy infestations near Calhan in Delbert county. Poplar borer, *Saperda calcarata*, was found on aspen and some cottonwood. The infestations were light, but one location north of Durango was particularly heavy and caused considerable stem breakage. Cottonwood leaf beetle, *Chrysomela scripta*, was found on cottonwoods along the Rio Grande River in Alamosa. All of the trees surveyed were heavily infested. Pitch-nodule moth, *Petrova arizonensis* was found on pinyon pine in Chaffee County, between Salida and Buena Vista. The infestation was light. Moderate infestations of *Eucosma sonomana* western pine shoot borer were found on ponderosa pine near Pagosa Springs, Woodland Park and in the Manitou Experiment Forest. Light infestations of pine tiger moth, *Halisidota ingens*, were found on ponderosa pine in Black Forest. Pine tip moths, *Rhyaciona* spp., were found on ponderosa pine throughout the state, especially in the plains area.

IN NEBRASKA:

An infestation of green-striped mapleworm, *Anisota rubicunda*, caused extensive defoliation to community shade trees in Sarpy and Douglas counties. Red turpentine beetle, *Dendroctonus valens*, was found on individual trees and small groups of trees in natural ponderosa pine stands along the Niobrara River and in Keya Paha, Brown, and Rock counties. Damage to ponderosa pine caused by pitch-nodule moth, *Petrova* spp., occurred in Lancaster, Banner, and Box Butte counties. Cottonwood leaf miner, *Agromyza populoides*, was found in abundance in some areas. Spruce needle miner, *Taniva albolineana*, and hickory leaf and petiole gall aphid, *Phylloxera* sp., were found throughout the state and appear to be increasing in abundance.

IN SOUTH DAKOTA:

Infestations of aspen leaf miner, *Phyllocnistis populiella*, were extremely heavy in the northern Black Hills and decreased in intensity south to Harney Peak. Casual observations of aspen on Terry Peak and in Spearfish Canyon found that almost all of the leaves on any one tree were infested. Light to moderate infestations of pitch-nodule moth, *Petrova metallica*, formerly

luculentana, were found in the ponderosa pine provenance planting and the perimeter planting at the Big Sioux Conifer Nursery in Watertown. Scattered light to moderate infestations of fall webworm, *Hyphantria* sp., were found on a range of hosts in the Black Hills. Light infestations of hackberry nipplegall maker, *Pachypsylla celtidismamma*, were found statewide. A chafer beetle, *F.* Scarabaeidae, infestation on aspen was particularly heavy in the northern Black Hills around Terry Peak and Spearfish Canyon.

STATUS OF DISEASES

DWARF MISTLETOES

DWARF MISTLETOE AND MOUNTAIN PINE BEETLE
Fig. 3

A preliminary survey was conducted in four separate areas along the Colorado Front Range to determine if ponderosa pine dwarf mistletoe, *Arceuthobium vaginatum* subsp. *cryptopodum*, predisposes trees to attack by the mountain pine beetle. The areas selected represented a range in stand conditions, mountain pine beetle activity, and dwarf mistletoe infection. A significant trend for the mountain pine beetle to infest dwarf mistletoe infected trees of the higher dwarf mistletoe rating (DMR) was noted in one area. Survey data also indicated that the beetle attacked the larger diameter trees in the stand.

Effective management and pest control strategies for ponderosa pine stands in the Front Range are dependent upon an assessment of both mountain pine beetle and dwarf mistletoe infestations. Future investigations will include studies on the interrelationship of dwarf mistletoe and mountain pine beetle under both endemic and epidemic levels of insect activity and comparisons of brood production in dwarf mistletoe infected and non-infected trees.

EXTENSIONS IN RANGE OF DWARF MISTLETOES
Fig. 4a

An extension of the range of lodgepole pine dwarf mistletoe, *Arceuthobium americanum*, on lodgepole pine was found in the Green Mountains of Wyoming where the parasite was common. Limber pine dwarf mistletoe, *Arceuthobium cyanocarpum*, was found on limber pine in the Seminoe Mountains and Crooks Mountains of Wyoming and in Red Canyon of the Park Range in Jackson County, Colorado. The

mistletoe was very damaging in these areas causing high levels of pine mortality. Pinyon dwarf mistletoe, *Arceuthobium divaricatum*, was found in Rio Blanco, Colorado 13 miles southeast of Rangely, thus extending the known northern limit.

STEM DISEASES

COMANDRA BLISTER RUST: *Cronartium comandrae*
Fig. 4b

An administrative study initiated in 1975 to determine the impact of Comandra blister rust on potential timber yield of pole-size or smaller lodgepole pine was continued in 1976. A total of 49 stands have been sampled over the past two years. Emphasis was to sample stands with 10 percent or more of the trees infected with the rust. Disease incidence ranged from 9 to 72 percent and mortality from rust ranged from 0 to 29 percent. Three of the 49 stands had over 20 percent mortality from rust; 33 stands had 10 percent or less mortality. Currently, the most obvious damage is spike top trees, which produce a very noticeable visual impact. However, stand averages indicated a low level of mortality and moderate level of rust damage. The data will be analyzed to determine the impact of the disease on growth and yield and associated management implications. Fortunately, very few recent infections (less than 10 years old) have been detected and then only in a limited number of stands in the seedling or sapling size classes. The observations and data collected during 1975 and 1976 will be used to develop silvicultural guidelines for managing infected stands.

DIPLODIA TIP BLIGHT: *Diplodia pinea*
Distribution Map, Fig. 4 c-d

Diplodia pinea was present in 38 of 44 counties surveyed in the eastern third of Nebraska. A list of the counties where the disease was detected follows:

Adams	Dixon	Lancaster	Richardson
Boone	Dodge	Nance	Saline
Burt	Douglas	Nemaha	Sarpy
Butler	Fillmore	Otoe	Saunders
Cass	Gage	Pawnee	Seward
Cedar	Hamilton	Phelps	Thayer
Clay	Jefferson	Pierce	Washington
Colfax	Johnson	Platte	Wayne
Cuming	Kearney	Polk	York
Dakota	Knox		

Austrian pine was the most commonly damaged species followed by ponderosa pine and Scots pine. Nearly half (47 percent) of all Austrian pine sampled were diseased.

THYRONECTRIA CANKER: *Thyronectria austro-americana*
Distribution Map

The fungus causing this canker was identified on honeylocust in Fort Collins, Colorado in 1974. Since then, it has been reported by Hudler and Oshima (1976) on honeylocust in 13 other communities in Colorado east of the Continental Divide (see map). 1/ The disease was widespread east of the mountains but the number of infected trees was low. Losses due to Thyronectria canker may increase if the present practice of favoring honeylocust plantings is continued.

OTHER STEM DISEASES

Ten acres of aspen along Clear Creek near Silver Plume, Colorado, were infected with canker-inciting *Ceratocystis*, *Cenangium* and *Hypoxylon* spp. Trees uphill from the creek were less severely affected. Siberian elm canker, caused by *Botryodiplodia hypodermia*, again was prevalent in many eastern South Dakota

1/ HUDLER, G. W. and H. OSHIMA. 1976. The occurrence and distribution of *Thyronectria austro-americana* on honeylocust in Colorado. Plant Dis. Reptr. 60:920-922.

shelterbelts. The disease also was found in several towns in northcentral South Dakota. Western gall rust, caused by *Endocronartium harknessii*, was reported infecting ponderosa pine in shelterbelts near Freeman, South Dakota. The disease is also present in the Black Hills.

VASCULAR WILTS

OAK WILT: *Ceratocystis fagacearum*
Distribution Map, Fig. 5

Aerial and ground surveys for this disease were completed in Kansas and Nebraska. As a result oak wilt was confirmed in two additional counties (Linn and Cherokee) in southeastern Kansas (see map).

DUTCH ELM DISEASE: *Ceratocystis ulmi*
Map - Distribution of Dutch Elm Disease

As a result of the passage of the National Forest Management Act of 1976 (PL 94-588), the Secretary of Agriculture, in consultation with the states, was directed to conduct a study of the incidence of Dutch elm disease (DED) and to evaluate methods for controlling spread of the disease. Accordingly, the states of Colorado, Kansas, Nebraska, South Dakota and Wyoming were contacted by FIDM personnel during December 1976 to assemble information on the disease. The status of the disease by states in the Rocky Mountain Region is summarized in Table 1 and in the following text. A map (see Appendix) shows the distribution of the disease.

TABLE 1 DUTCH ELM DISEASE SUMMARY R-2

State	Total Counties in State	Counties With DED	Year DED First Reported (1948) Initial Report	Estimated Number of Elms in Incorporated Areas Before DED	Estimated Number of Elms in Incorporated Areas 1976	Percent Tree Loss	Current Annual Expenditure for Survey and Control
Colorado	63	24	1968	1,943,997	1,931,352	1.0	$1,443,106
Kansas	105	105	1957	1,141,000	685,000	30.0	$ 400,000
Nebraska	93	90	1960	245,000	137,500	43.9	NONE
South Dakota	65	48	1967	150,000	120,000	20.0	$ 74,885
Wyoming	19	1	1969	Unknown 1/	Unknown 2/	----	NONE

1/ Elm population of Cheyenne not known. It has been estimated that 3 percent of the shade tree population is elm.

2/ A total of 10 - 15 trees have been lost to DED in Cheyenne.

IN COLORADO:

Initially reported in Colorado in 1948 and recurring in 1968, DED has since been positively identified in 24 of the 63 counties in the state (see map). Before the disease was introduced it was estimated that there were 1,943,997 elms (all species) in incorporated and rural areas. Today there are 1,931,352 trees which represents a 1 percent reduction of the original elm population.

Currently 51 municipalities (13 percent of all and 43.6 percent of the 117 critical areas) have some type of survey and control program; however, many are not yet very effective. Total annual expenditures by state and local governments and the private sector are estimated at $1,443,106.

Control of DED in Colorado has been based on sanitation -- the removal and disposal of dying or dead elm trees and trees known to be infected with *C. ulmi*. Disposal has been primarily by burial in land fills with smaller amounts burned, chipped or utilized by local sawmills. Preventive spraying for bark beetles with methoxychlor is used only in a few municipalities, although its use on individual trees through private landowner-commercial arborist contracts is increasing. Costs of removal of condemned trees are generally borne by owners, although some municipalities bear the entire cost and others have initiated some form of cost sharing or cost abatement programs.

The primary obstacle to the development of effective DED control programs is lack of, or misdirection of, public education coupled with the lack of strong coordination of the various facets of control. The most effective tool for information dissemination is availability of a professional to talk directly with the people. The success of the program in Colorado is due primarily to assigning this responsibility to State Forest Service district personnel.

IN KANSAS:

DED was discovered in Kansas City, Kansas in October 1957 and now is reported in all counties in the state (see map). Prior to the introduction of the disease, it was estimated that there were 1,141,000 elms in incorporated areas. Today there are 685,000 trees which represents a 40 percent reduction of the original elm population. A 1974 analysis of street tree inventories taken of

67 Kansas towns between 1971 and 1974 revealed that American elms constituted 22.7 percent of all street tree species inventoried.

An estimated 25 percent of all Kansas cities and towns have survey and control programs. Control is primarily by sanitation, not necessarily for control reasons, but because dead trees must be removed. Annual control costs are estimated at $400,000. Multi-faceted control programs (spraying, sanitation, injection and root graft control) were begun in many cities. Some programs operated well for a few years, but all lacked the continuing commitment needed for success. Losses have been heavy in many areas creating obvious strains on budgets for removal. The major obstacle is the lack of commitment to the elements necessary for control: funding, ordinances and application of control measures.

IN NEBRASKA:

DED was discovered in Omaha, Nebraska in 1960 and now is reported in all counties in the state except Banner, Grant and Hooker (see map). Prior to the introduction of the disease, it was estimated that there were 245,000 elms in incorporated areas. Today there are 137,500 trees, which represents a 44 percent reduction of the original elm population.

Currently there is no annual expenditure of public funds for survey and control of the disease. During the 1960's some cities removed trees on city property and passed ordinances to remove trees on private property. Control work also consisted of pruning healthy elms and application of a late dormant spray of DDT up to 1971. From 1971-72, methoxychlor was used. Limited tests with Bidrin were made in Lincoln, Nebraska City, and Omaha in 1964. Control efforts were abandoned in 1972 in Lincoln.

Tree replacement programs have been in effect in many cities. The emphasis has been on replacement with species such as maples and catalpa.

IN SOUTH DAKOTA:

DED was first reported in 1967 in the vicinity of Sioux Falls and Platte. Since the initial report, the disease has been detected in 48 of the 65 counties in the state (see map). Prior to the introduction of the disease, it was estimated that there were some 150,000 elms. Today there are 120,000 trees, a 20 percent reduction of the original elm population.

Currently 70 percent of the towns and cities in South Dakota with a population of 250 or more have some type of DED survey and control program. The annual expenditure in FY'77 for the Division of Forestry, Community Forestry and South Dakota Extension Service programs will be $74,885.

Survey methods consist of street and park tree surveys by district foresters assisted by state community forestry specialists and city officials. The survey is contingent on an agreement by the city to remove and destroy infected trees prior to beetle emergence. Tree destruction is primarily by burning, however, some burial and chemical treatment has been used. Some communities have initiated preventive and curative programs using lignasan injection. The effectiveness of this treatment has not been established and the State Division of Forestry neither endorses nor disapproves these efforts.

The state program goal is to retard the progression and severity of the disease through timely sanitation removal. The primary effort is a well-balanced tree replacement and maintenance program. Information is disseminated to the public in brochures, arborist newsletters and arborist training sessions.

IN WYOMING:

DED was discovered in Cheyenne in 1969. As of 1976 only one county (Laramie) reported diseased trees (see map). No figures are available on the number of elms present in incorporated areas prior to the introduction of the disease; however, 3 percent of the shade trees in Cheyenne are elm. As of 1976 a total of 10 to 15 trees were removed at an average cost of $30.00 each.

There is no current program for control of the disease, although 3 to 5 elm specimens are submitted each year to the Plant Clinic at the University of Wyoming, Laramie, for diagnosis. Tree

replacement with cottonwood, green ash, honeylocust and ponderosa pine is emphasized.

ROOT DISEASES

SHOESTRING ROOT ROT: *Armillariella mellea*
Distribution Map, Fig. 6

A survey of root diseases in managed conifer stands of the Region was initiated in 1976. Stands of ponderosa pine and lodgepole pine in the San Juan, Rio Grande, Routt, and Arapaho National Forests thinned 5 to 15 years ago contained several centers of *Armillariella mellea* as well as many declining and scattered dead trees. Scattered mortality was also noted in white fir, subalpine fir, Engelmann spruce, limber pine and Douglas-fir. In some ponderosa pine and lodgepole pine stands the disease killed enough trees to result in less than desirable levels of stocking. Plots will be established to follow the progress of the disease in various forest types and determine its impact on management objectives.

Aerial and ground surveys of pinyon-juniper stands in 1975 and 1976 revealed many centers of dying and dead trees. *Verticicladiella wagenerii*, the cause of black stain root disease, was isolated from disease centers west of the Continental Divide; [2/] whereas, *A. mellea* was isolated east of the Divide (see map). A ground survey was conducted in a heavily-infected area on BLM land 3 to 6 miles north of Cotopaxi, Colorado. Fifteen percent of the pinyon in the survey plots was dying or dead from *A. mellea* infection. The centers have been active for some time and apparently are spreading

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2/ LANDIS, T. D. and L. B. HELBURG. 1976. Black stain root disease of pinyon pine in Colorado. Plant Dis. Reptr. 60: 713-717.

very slowly. *Armillariella mellea* was isolated from Rocky mountain juniper north of Cotopaxi. This is a new host record for the United States. [3/]

WEATHER DAMAGE
Fig. 7 a-b

Weather records for mountainous areas of Colorado showed that a sudden freeze and snowfall occurred June 14 (northern half of the state) and June 15 (southern half). Temperatures dropped 10 to 15° F below average for the first two weeks of June to 15° F at many weather stations (see map). Foliage damage to aspen, Gambel oak and conifers was widespread. Extensive damage to conifers occurred along the Buford-New Castle Road north of New Castle, Colorado, in the Rifle Ranger District, White River National Forest. Mixed stands of white fir, Engelmann spruce and aspen were affected. Both older and current year foliage exhibited injury. Individual trees showed a differential response to the injury. Native spruce and fir in plantations also were damaged.

In the Roosevelt National Forest in the upper Pennock Creek and Pingree Park areas, about 200 acres (in about 50-acre areas) of trees located on exposed ridges were damaged by winter drying. Lodgepole pine was most seriously affected but associated subalpine fir and limber pine were also damaged. All foliage was killed on some large trees. Most trees are expected to recover from the injury; however, growth will be affected for several years until a full complement of foliage develops.

In Wyoming, drought caused much wilting of American elms which confused the identification of Dutch elm disease. Weather problems in Nebraska included scorch of hardwoods and winter dessication of conifers. Drought damage to redcedar shelterbelts was reported from North Platte, Hershey and Maxwell, Nebraska.

3/ JOHNSON, D. W., T. D. LANDIS, and L. S. GILLMAN. 1976. Rocky mountain juniper, a new host of *Armillariella mellea* in Colorado. Plant Dis. Reptr. 60:886.

NURSERY PROBLEMS

FUSARIUM ROOT DISEASE: *Fusarium* spp.

Species of *Fusarium* caused a cortical rot of containerized Douglas-fir, Engelmann spruce and pinyon in the Colorado State Forest Service greenhouse in Fort Collins. The disease is distinct from damping off, since it occurred after secondary thickening of seedling tissues. Of the over 10,000 4 month-old Douglas-fir seedlings examined 15 percent had died from this disease.

SEEDLING LOSS
Fig. 7 c-d

A seedling loss analysis conducted at the Forest Service, USDA, Mt. Sopris Tree Nursery, Carbondale, Colorado, revealed that damping-off fungi and bird predation were the major causes of loss. An average of 25 percent of emerged seedlings of all species were killed by damping-off fungi in the first 6 weeks of growth. Losses were variable over the nursery ranging from 0 to 80 percent. Bird feeding was responsible for losses up to 25 percent of sown seed but varied between tree species. Losses were lowest (1 to 3 percent) for Engelmann spruce and highest for ponderosa pine (as high as 50 percent).

HERBICIDE TESTS
Fig. 8

Tests of preemergence and contact herbicides in seedbeds at Mt. Sopris Tree Nursery revealed several promising new chemicals for weed control. Modown, Devrinol, Amex-820, and Dacthal provided the best control of undesirable weeds and had the lowest phytotoxicity to nursery stock. Lorox proved to be an effective contact herbicide when applied as a dormant spray to 2- and 3-year-old conifers in late summer.

WESTERN GALL RUST

Ponderosa pine seedlings lifted from Bessey Nursery have been sampled every other year since 1971, held in a lath house for 3 years, and examined for symptoms of western gall rust. Examination of 677 ponderosa pines collected from the nursery in 1973 yielded only one rust-infected tree. If the rust continues at a low level the last nursery sample will be taken in 1977.

PROBLEMS AT BIG SIOUX CONIFER NURSERY, SOUTH DAKOTA

Phomopsis blight, caused by *Phomopsis juniperovora*, has been a recurring problem to production of eastern redcedar at the nursery. The disease is being controlled by applications of Benomyl. Damping-off also has been a problem on species improperly planted. Control can be achieved by planting seed at the proper time. Five beds of spruce were infected with a needle blight this year. Chemical control with Bordeaux will be attempted in 1977.

MISCELLANEOUS STUDIES

LODGEPOLE PINE TUMOR
Fig. 9

Overmature lodgepole pine in the vicinity of Round Park in the Green Mountains of Wyoming were found to be infected with tumors of an unknown cause. Lodgepole pine and limber pine of all ages were affected. Tumors occurred singly or in groups along trunks and branches. Hundreds of tumors were noted on many trees. A survey in one area indicated that 70 percent of the trees per acre had tumors. This represented 74 percent of the basal area. No obvious mortality was associated with the tumors; however, trees were deformed and future utilization will be adversely affected. The tumors consisted of modified xylem extending from near the pith to the cambium in a conical zone. No discoloration or decay was noted behind the tumors. Similar tumors were reported on lodgepole pine, limber pine, Douglas-fir and subalpine

fir by Peterson in 1961 [4/]. Insects were suspected as initiating the damage, although this has not been confirmed.

MYCORRHIZAE

Over 2500 container-grown ponderosa pine seedlings were inoculated with 3 species of ectomycorrhizal fungi at the Colorado State Forest Service greenhouse. *Pisolithus tinctorius*, *Cenococcum graniforme* and *Suillus granulatus* were added to the normal potting mix in two different treatments. One treatment consisted of adding vegetative inoculum as a top dressing to potted seedlings. The other treatment consisted of mixing inoculum into the potting mix at a rate of 20 percent by volume. These seedlings will be outplanted in the spring of 1977 to evaluate the effects of ectomycorrhizae on survival and growth. During 1976 a preliminary examination of outplanted ponderosa pine seedlings on the San Juan National Forest with *P. tinctorius* ectomycorrhize showed a 2.5-fold increase in survival over non-mycorrhizal seedlings.

OTHER DISEASES
Distribution Map

Hackberry decline was a widespread problem in Nebraska, with several reports from York, Garfield, Valley, and Lincoln counties. The cause was not determined; herbicide drift was suspected. Diseases of minor occurrence in Nebraska included walnut and sycamore anthracnose (caused by *Gloeosporium* sp.), *Dothistroma pini* needle blight, Cytospora canker of cottonwood, and Verticillium wilt of maple and catalpa. Rhabdocline needlecast, caused by *Rhabdocline pseudotsugae*, was detected on Douglas-fir near Woods Landing in the Medicine Bow National Forest, Wyoming. In South Dakota, ash anthracnose (*Gloeosporium* sp.) caused some defoliation of green ash in the Yankton area, *Fomes fraxinophilus* was observed in native green ash stands in the Missouri and James River bottoms, and *Phytophthora citricola* was implicated in infection of some outplantings of black walnut seedlings.

4/ PETERSON, R. S. 1961. Confier tumors in the Central Rocky Mountains. Plant Dis. Reptr. 45:472-474.

FIGURE 1

WESTERN SPRUCE BUDWORM

(a) Defoliation of Douglas-fir by spruce budworm

(b) Douglas-fir treated with acephate

(c) Closeup of foliage

Left: nontreated
Right: treated with acephate

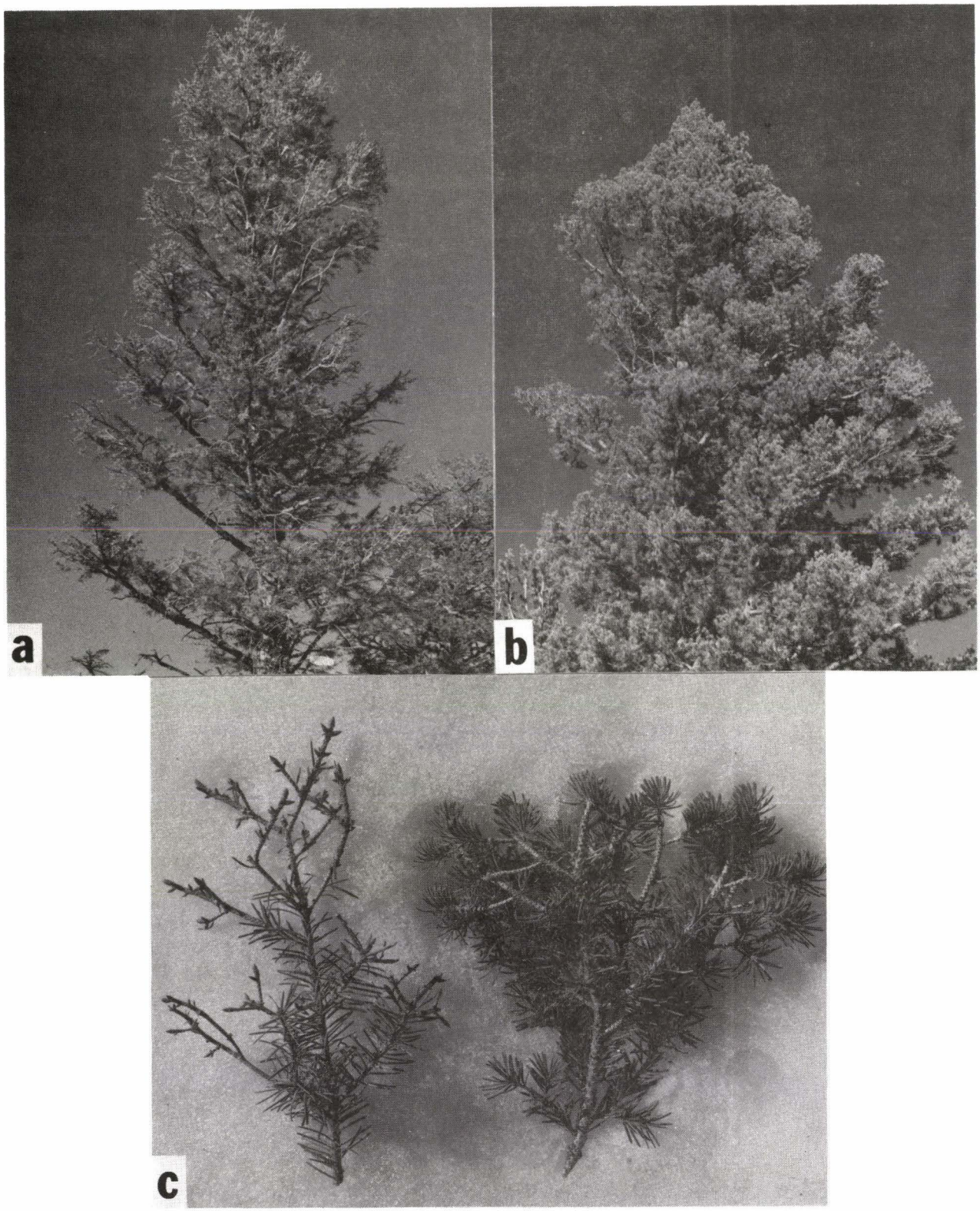
a
b
c

FIGURE 2

ZIMMERMAN PINE MOTH

(a) Top kill of *Pinus nigra* by Zimmerman pine moth

(b) Pitch tube of Zimmerman pine moth

(c) Top breakage of *P. nigra* caused by Zimmerman pine moth (broken at arrow)

(d) Closeup of top breakage

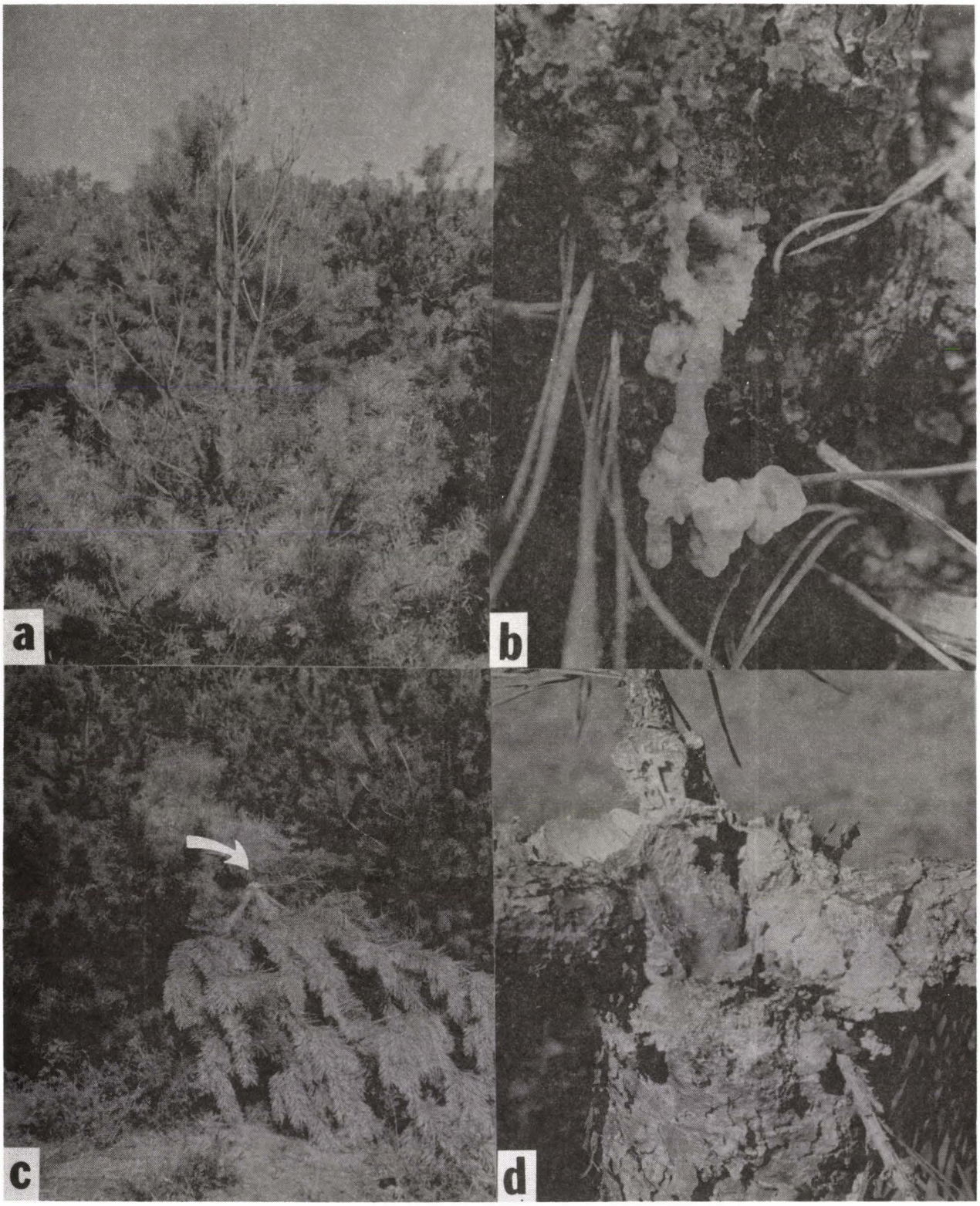
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FIGURE 3

DWARF MISTLETOE AND MOUNTAIN PINE BEETLE

(a) Ponderosa pine with dwarf mistletoe, *Arceuthobium vaginatum* subsp. *cryptopodum*

(b) Dwarf mistletoe infested trees were killed by mountain pine beetle.

(c) Closeup of ponderosa pine dwarf mistletoe

(d) Surveys were conducted in four areas of the Front Range

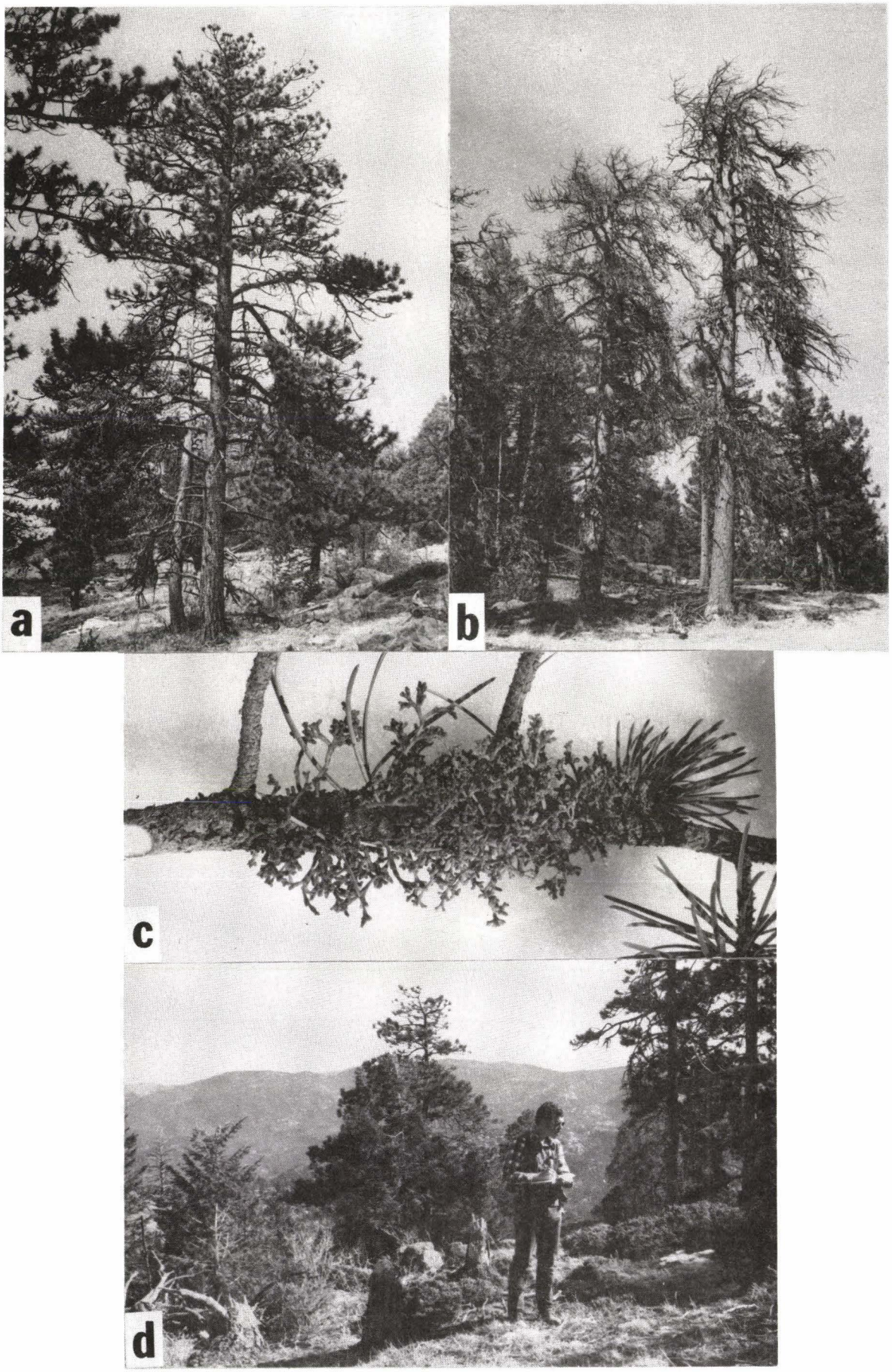
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FIGURE 4

(a) **LIMBER PINE DWARF MISTLETOE** - caused heavy mortality in several areas.

(b) **COMANDRA BLISTER RUST** - caused spike tops of lodgepole pine

(c) **DIPLODIA TIP BLIGHT** - branch of Austrian pine with Diplodia tip blight (see arrow)

a
b
c

FIGURE 5

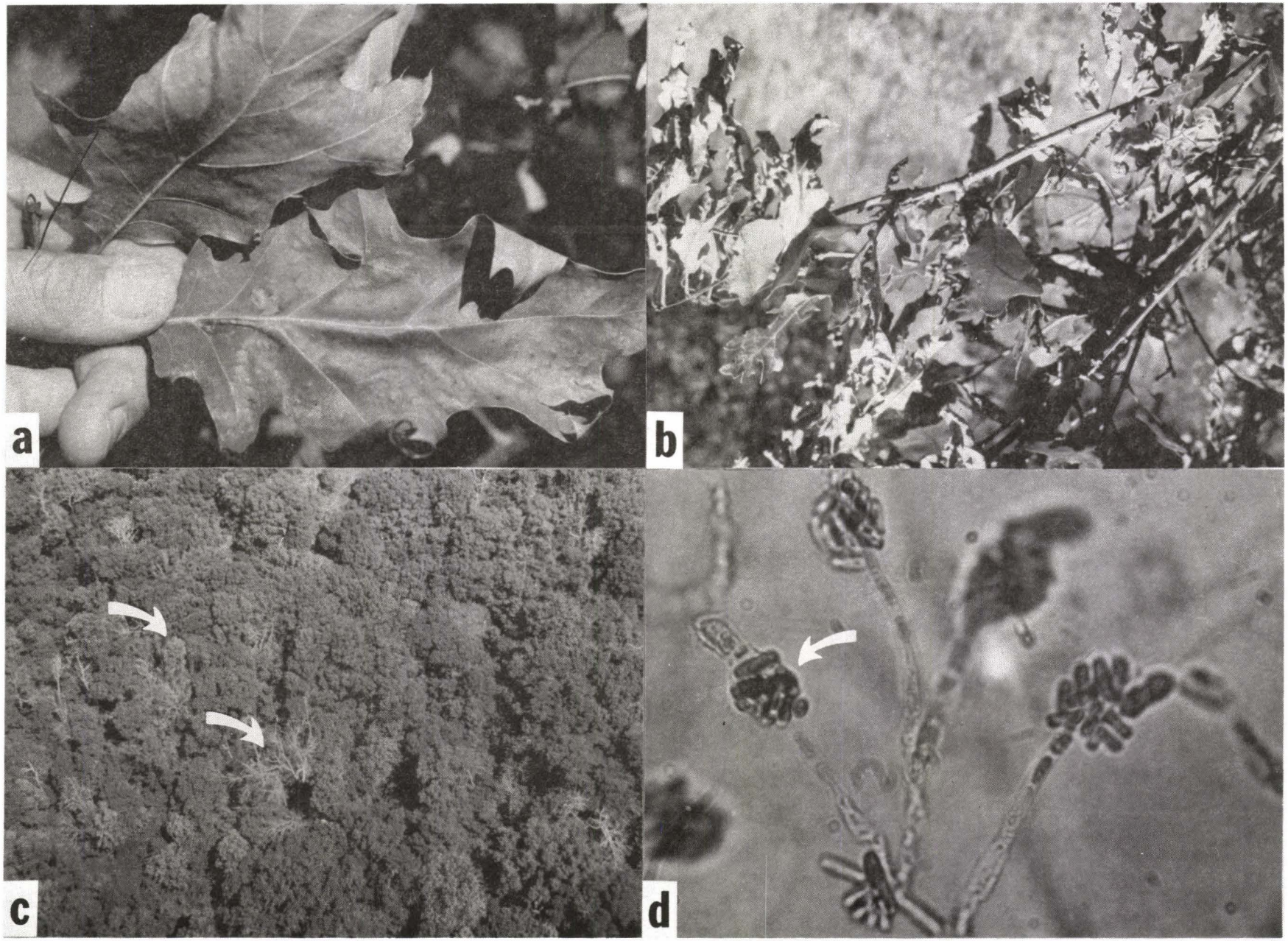
OAK WILT

(a) & (b) Foliage symptoms - leaves turn brown beginning at edges and tip, with a distinct line between green and brown areas.

(c) Aerial photo of disease center

Top arrow: fading tree
Lower arrow: dead tree

(d) Photomicrograph of the oak wilt fungus - arrow points to a cluster of conidia.


a
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c
d

FIGURE 6

SHOESTRING ROOT ROT: *Armillariella mellea* OF ROCKY MOUNTAIN JUNIPER

(a) Infected juniper

(b) Juniper killed by *A. mellea*

(c) Excavation of juniper showing root contact by which the fungus moved.

(d) *A. mellea* isolate from juniper on agar media (view of bottom of culture dish) showing rhizomorphs (black root-like structures)

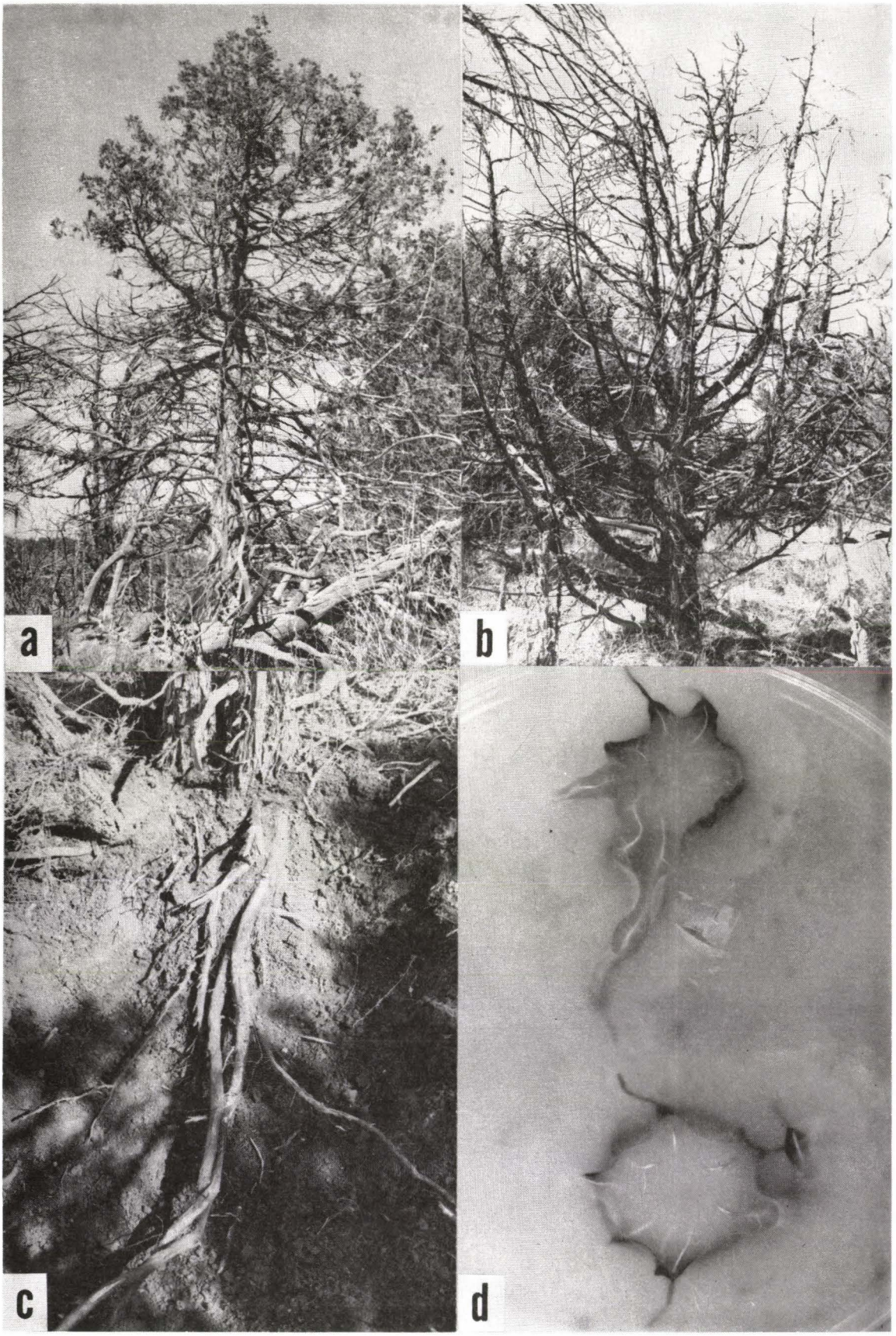
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FIGURE 7

WEATHER DAMAGE - June 15, 1976

Freeze on the Rifle Ranger District
White River National Forest

(a) Engelmann spruce - both older and current year foliage are red.

(b) Lodgepole pine - older foliage has dropped and current foliage has emerged since the freeze.

SEEDLING LOSS AT MT. SOPRIS TREE NURSERY

(c) Damping-off fungi caused high mortality. (Arrow points to toppled seedlings)

(d) Bird feeding was responsible for losses up to 25 percent of sown seed.

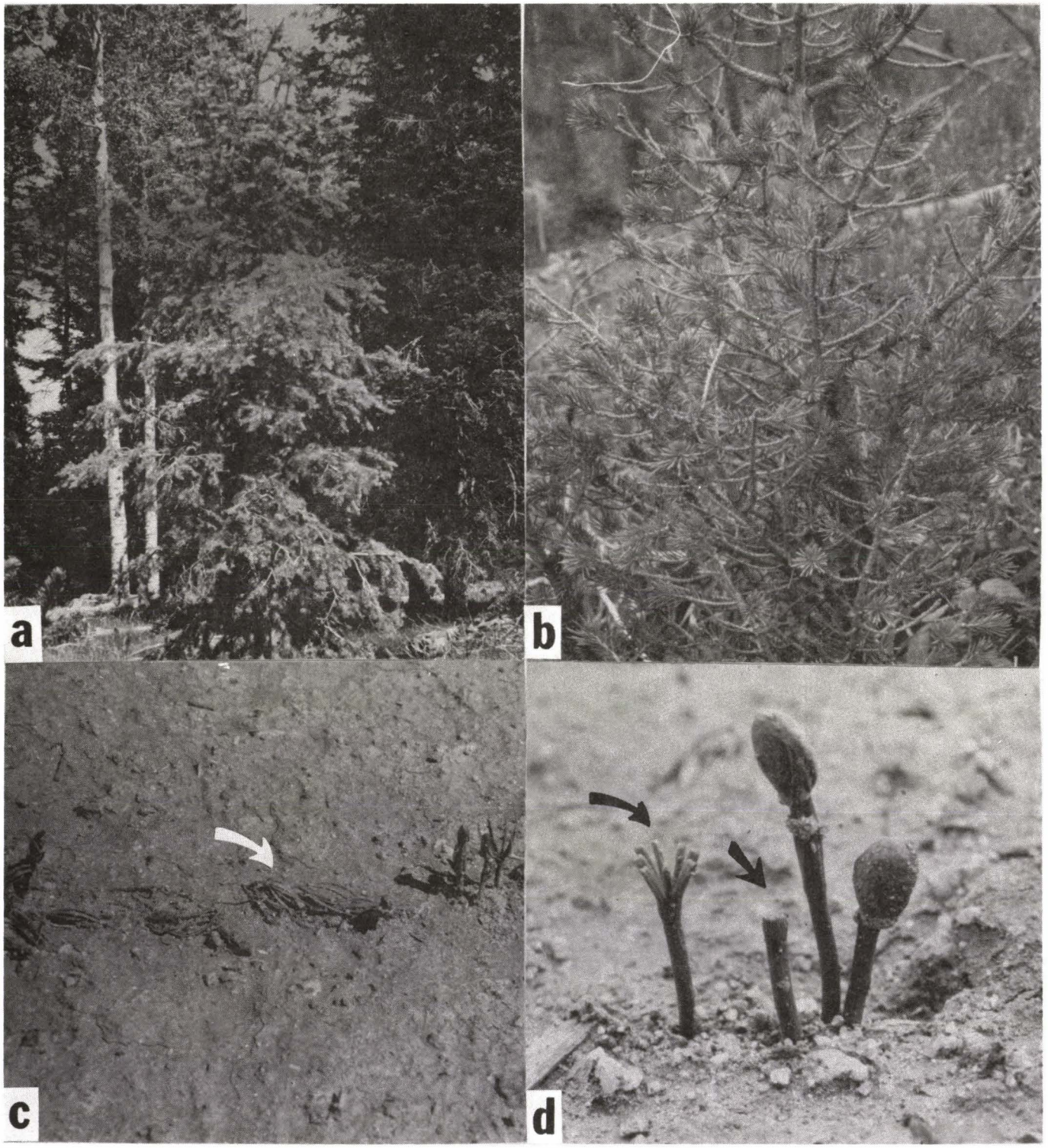
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FIGURE 8

HERBICIDE TESTS AT MT. SOPRIS TREE NURSERY

(a) Row of Engelmann spruce seedlings overrun with purslane - (arrow points to row of trees)

(b) Modown showed potential as a contact herbicide, controlling the existing purslane without damaging the seedlings.

(c) Pre-emergence herbicide: contrast between treated and untreated plots.

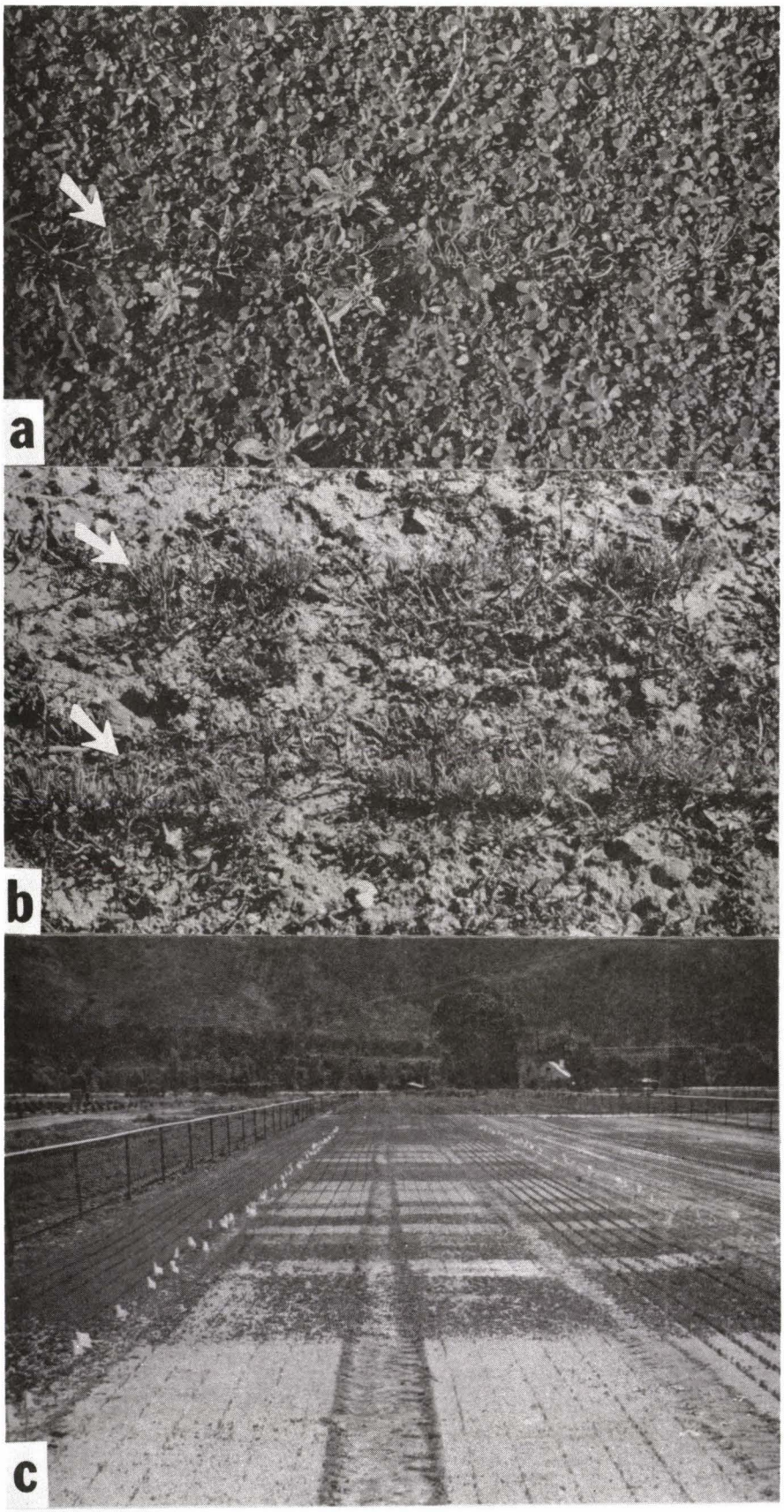
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FIGURE 9

TUMORS OF UNKNOWN CAUSE ON LODGEPOLE PINE

(Green Mountains, Wyoming)

(a) & (b) Closeups of tumors on trunks

(c) & (d) Lodgepole pine with multiple tumors

a
b
c
d

FOREST SERVICE, USDA, DETECTION REPORT
FOREST INSECT AND DISEASE DAMAGE
R-2 5200-2

To encourage forest pest reporting for the Rocky Mountain Region, we invite all interested agencies to complete Form R-2 5200-2. Instructions for completing the form are found at the top of the page on each form.

Copies of R-2 5200-2 are available upon request from the Forest Service, State and Private Forestry, Forest Insect and Disease Management, 11177 West 8th Avenue, Post Office Box 25127, Lakewood, Colorado 80225, Phone (303) 234-4877.

Whenever possible, insect or disease specimens or damage samples should be submitted with the form. Resource managers of Federal forest lands should submit specimens for identification to the Forest Insect and Disease Management Staff at the above address. Managers of non-Federal forest lands in Colorado, Kansas, Nebraska, South Dakota, and Wyoming should send detection reports and specimens to their respective state forestry organizations. A complete listing follows:

STATE FORESTRY ORGANIZATIONS

Colorado State Forest Service
State Forester - Thomas B. Borden
Colorado State University
Fort Collins, Colorado 80523
Telephone: (303) 482-8185,
491-6304/6305

Kansas State and Extension Forestry
State and Extension Forester
Harold G. Gallaher
Forestry Building, 2610 Claflin Road
Manhattan, Kansas 66502
Telephone: (913) 532-5752

Nebraska State and Extension Forestry
Chairman, Department of Forestry and
State Forestry - Mitchell D. Ferrill
201 Miller Hall, University of Nebraska
Lincoln, Nebraska 68503
Telephone: (402) 472-2944

South Dakota State Division of
Forestry
Director of Forestry -
James D. Verville
Sigurd Anderson Building
Pierre, South Dakota 57501
Telephone: (605) 224-3481

Wyoming State Forestry Division
State Forester - Carl E. Johnson
113 Capitol Building
Cheyenne, Wyoming 82002
Telephone: (307) 777-7586

USDA–Forest Service

USDA - FOREST SERVICE
DETECTION REPORT
FOREST INSECT AND DISEASE DAMAGE

INSTRUCTIONS: After detection of insect or disease activity
(a) Immediately prepare detection report in 4 parts.
(b) Part 1 & 2 sent to Regional Forester, Forest Service, S&PF, USDA, 11177 W 8th Ave. P.O. Box 25127, Lakewood, Colorado 80225.
(c) Send Part 3 to Supervisor Unit
(d) Retain Part 4
(e) Forest Pest Mgmt. will acknowledge, answer and return.

PEST DETECTION IS FOR YOUR PROTECTION

Be alert. Report promptly any new or unusual forest pest to the Regional Forester (See FSM 5220).
Forest Pest Management

•

Pest Management action on your Detection Report: _____ (date)

- ☐ Answer
- ☐ Lab rearing & will reply at later date.
- ☐ Sent out for identification & will reply at later date.
- ☐ Sample was damaged, please send another under different packaging.

Administrative Unit _____ (Forest, National Park, etc.)
Sub-Unit _____ (Ranger, District, etc.)
Date of Observation _____
Observed by _____
Location of Damage (Attach ¼" scale map)

_____

_____

GENERAL INFORMATION

Host _____ Avg. d.b.h. _____

Size class affected:
- ☐ Seedlings
- ☐ Saplings
- ☐ Poles
- ☐ Sawtimber
- ☐ Overmature timber

Damaged standing Stems/acre _____
Down stems/acre _____ (Blowdown, slash, cull, etc.)
Number of acres infested _____
Damage to:
- ☐ Single Trees
- ☐ Groups _____ (No. of) _____ (No. per)

TREE DAMAGE SYMPTOMS–(Check term(s) applicable)

Crown:
- ☐ Top
- ☐ Middle
- ☐ Lower
- ☐ Entire
- ☐

Needles or leaves:
- ☐ Chewed
- ☐ Mined
- ☐ Webbed
- ☐ Spotted
- ☐ Discolored
- ☐ Missing

Tree foliage:
- ☐ Green
- ☐ Fading
- ☐ Sorrel
- ☐ Red
- ☐ Brown
- ☐ Black

Enclosures:
- ☐ Appropriate Maps
- ☐ Damage Samples
- ☐ Insect Specimens

Damage to:
- ☐ New Foliage
- ☐ Old Foliage
- ☐ Both

Tree bole:
- ☐ Cracked
- ☐ Sluffed bark
- ☐ Boring dust
- ☐ Pitch tubes
- ☐ Woodpecker feeding
- ☐ Canker
- ☐ Conks
- ☐ Pitch flow

Branches:
- ☐ Broken
- ☐ Swollen
- ☐ Discolored
- ☐ Cankers
- ☐ Mistletoe shoots
- ☐ Girdled
- ☐ Brooms

Associated disturbance:
- ☐ Fire
- ☐ Logging
- ☐ Thinning
- ☐ Blowdown
- ☐ Insects
- ☐ Disease

Unusual weather conditions:
- ☐ Wind
- ☐ Rain
- ☐ Hail
- ☐ Sleet
- ☐ Snow
- ☐ Flood
- ☐ Drought

INFESTATION OR INFECTION CHARACTERISTICS

Insect(s) or Disease(s) if known _____ How long active _____

Status: Static _____ Decreasing _____ Increasing _____ Unknown _____

Remarks: _____

(FOR REGIONAL OFFICE USE ONLY)

Remarks:

Unisort Cards _____ (Yr Pest No) Date _____ Acknowledged By _____

4

R-2 5200-2 (3/75)

BIOLOGICAL EVALUATIONS COMPLETED DURING 1976

BY THE

FOREST INSECT AND DISEASE MANAGEMENT STAFF (R-2)

REPORT TITLE	FI&DM FILE DESIGNATION
Dwarf Mistletoe - Arapaho and Roosevelt National Forests, Red-Feather Ranger District	R2-76-1
Examination of Bessey Nursery Stock for Western Gall Rust	R2-76-2
Mountain Pine Beetle - Black Hills of South Dakota and Wyoming, Black Hills National Forest and Surrounding State, Private and other Federal Lands	R2-76-3
Mountain Pine Beetle - National Forest Lands - Colorado Front Range, Arapaho and Roosevelt AND Pike and San Isabel National Forests	R2-76-4
Mountain Pine Beetle - Bighorn Front Range - Bighorn National Forest, Bureau of Land Management, State and Private Lands	R2-76-5
Mountain Pine Beetle - Middle Park, Colorado Arapaho National Forest	R2-76-6
Oak Wilt Detected in 5 New Counties in Kansas and Nebraska	R2-76-7

REPORT TITLE	FI&DM FILE DESIGNATION
Mountain Pine Beetle - Black Hills of South Dakota and Wyoming - Black Hills National Forest, Private and State Lands	R2-76-8
Colorado Front Range - Arapaho and Roosevelt; Pike and San Isabel National Forests, Rocky Mountain National Park	R2-76-9
Mountain Pine Beetle - Shoshone National Forest, Bureau of Land Management, State and Private Land, Wyoming	R2-76-10
Western Spruce Budworm - Federal, State Lands in Colorado and Wyoming	R2-76-11
Rawlins District, Bureau of Land Management, Green Mountain Wyoming	R2-76-12
Mountain Pine Beetle - Ute Pass DCA, Pike National Forest	R2-76-13
Shoestring Root Rot of Pinyon-Juniper Stands - San Isabel National Forest, Bureau of Land Management, State and Private Lands	R2-76-14
Effectiveness of Soil Fumigation with Methyl Bromide-Chloropicrin at Mt. Sopris Tree Nursery	R2-76-15
Fusarium Root Disease of Containerized Tree Seedlings - Colorado State Forest Service Nursery, Fort Collins, Colorado	R2-76-16

REPORT TITLE	FI&DM FILE DESIGNATION
An Evaluation of Seedling Inventory Sampling Methods at Mt. Sopris Tree Nursery, Carbondale, Colorado	R2-76-17
An Analysis of Seed and Seedling Losses at Mt. Sopris Tree Nursery	R2-76-18

TECHNICAL REPORTS COMPLETED DURING 1976

BY THE

FOREST INSECT AND DISEASE MANAGEMENT STAFF (R-2)

REPORT TITLE	FI&DM FILE DESIGNATION
Tree Hazards: Recognition and Reduction in Recreation Sites February, 1976	R2-1
Soil and Water Quality in Relation to Lodgepole Pine Culture at Mt. Sopris Nursery February, 1976	R2-2
Mycorrhizal Inoculation of Container Grown Ponderosa Pine Seedlings May, 1976	R2-3
Dwarf Mistletoe as a Predisposing Factor for Mountain Pine Beetle Attack of Ponderosa Pine in the Colorado Front Range August, 1976	R2-4
UNASSIGNED	R2-5
Parasitism of Douglas-Fir Tussock Moth Eggs in Denver November, 1976	R2-6
Herbicide Testing at Mt. Sopris Tree Nursery November, 1976	R2-7
Sodium Fluoraluminate as a Pesticide for Controlling Western Spruce Budworm (Choristoneura occidentalis Free.) December, 1976	R2-8

INDEX OF INSECTS

	Reported In The Following States During 1976 1/	Page
Agromyza populoides Spencer	N	12
Anisota rubicunda (F.)	N	12
Apanteles fumiferanae (Viereck)	C	9
Aspen leaf miner	SD	12
Bracon spp.	C	9
Ceromasia spp.	C	9
Chafer beetle	SD	13
Choristoneura lambertiana ponderosana Obraztsov	C	11
Choristoneura occidentalis Freeman	C, W	4, 8
Chrysomela scripta F.	C	12
Coccygomimus pedalis (Cresson)	C	9
Coleotechnites sp.	C	11
Cottonwood leaf beetle	C	12
Cottonwood leaf miner	N	12
Dendroctonus ponderosae Hopk.	C, W, SD	6, 4, 14
Dendroctonus pseudotsugae Hopk.	C, W	8
Dendroctonus rufipennis (Kirby)	C, W	7
Dendroctonus valens LeC.	N	12
Dioryctria zimmermani (Grote)	C, SD, N	4, 10
Douglas-fir beetle	C, W	8
Douglas-fir tussock moth	C	9
Elm leaf beetle	SD, N	4, 11
Epinotia meritana Heinrich	C	10
Eucosma sonomana Kearfott	C	12
Fall webworm	SD	4, 13
Forest tent caterpillar	C, SD	9
Glypta fumiferanae (Viereck)	C	9
Grasshoppers	SD	11
Green-striped mapleworm	N	12
Hackberry nipplegall maker	SD	13
Halisidota ingens Hy Edws.	C	12
Hickory leaf and petiole gall aphid	N	12
Hyphantria sp.	SD	4, 13
Hyposoter spp.	C	10

	Reported In The Following States During 1976 1/	Page
Ips pini (Say)	C, W, SD, N	8
Malacosoma americanum (F.)	C	9
Malacosoma californicum (Packard)	C	9
Malacosoma disstria Hubner	SD	9
Malacosoma incurvum discoloratum (Neumoegen)	C	9
Melanoplus sp.	SD	11
Mountain pine beetle	C, W, SD	4, 6, 14
Neodiprion fulviceps (Cresson)	C, SD, N	4, 10, 11
Neophasia menapia Feld	C	12
Orgyia pseudotsugata (McD.)	C	9
Pachypsylla celtidismamma (Riley)	SD	13
Petrova arizonensis (Heinrich)	C	4, 12
Petrova metallica (Busck)	SD	4, 12
Petrova spp.	N	4, 12
Phaeogenes harioles (Cresson)	C	9
Phyllocnistis populiella Chamb.	SD	12
Phylloxera spp.	N	12
Pine butterfly	C	12
Pine needle miner	C	11
Pine tiger moth	C	12
Pine tip moths	C, N, SD	12
Pitch-nodule moth	C, N, SD	4, 12
Poplar borer	C	12
Pyrrhalta luteola (Mueller)	SD, N	4, 11
Red turpentine beetle	N	12
Rhyacionia spp.	C, N, SD	12
Rogas spp.	C	9
Saperda calcarata Say	C	12
Sawflies	C, SD, N	4, 10, 11
Spruce beetle	C, W	7
Spruce needle miner	N	12
Sugar pine tortrix	C	11
Taniva albolineana (Kearfott)	N	12
Telenomus californicus (Ashm.)	C	9
Tachinid fly	C	10
Tent caterpillars	C, SD	9

	Reported In The Following States During 1976 [1]	Page
Western pine shoot borer	C	12
Western spruce budworm	C, W	4, 8
White fir needle miner	C	10
Zimmerman pine moth	C, SD, N	4, 10

[1]
C - Colorado
K - Kansas
N - Nebraska
SD - South Dakota
W - Wyoming

INDEX OF DISEASES

	Reported In The Following States During 1976 [1/]	Page
Anthracnose	N	26
Arceuthobium americanum Nutt. ex Engelm.	W	14
Arceuthobium cyanocarpum Coulter & Nels.	C, W	14
Arceuthobium divaricatum Engelm.	C	15
Arceuthobium vaginatum subsp. *cryptopodum* (Engelm.) Hawks. & Wiens	C	14
Armillariella mellea (Fr.) Karst.	C	4, 22
Aspen cankers	C	16
Bird feeding	C	4
Black stain root disease	C	22
Botryodiplodia hypodermia (Sacc.) Petr. & Syd.	SD	16
Cenangium sp.	C	16
Cenococcum graniforme (Sow.) Ferd. & Winge	C	26
Ceratocystis sp.	C	16
Ceratocystis fagacearum (Bretz) Hunt	K, N	4, 17
Ceratocystis ulmi (Buism.) C. Mor.	C, K, N, SD, W	4, 17
Comandra blister rust	W	4, 15
Cronartium comandrae Peck	W	4, 15
Cytospora canker	N	26
Damping-off	C, SD	24
Diplodia pinea (Desm.) Kickx.	N	4, 15
Diplodia tip blight	N	4, 15
Dothistroma pini Hulb.	N	26
Drought damage	N, W	23
Dutch elm disease	C, K, N, SD, W	4, 17
Endocronartium harknessii (J. P. Moore) Y. Hiratsuka	N, SD	17, 25
Fomes fraxinophilus (Peck) Sacc.	SD	26
Fusarium root disease	C	24
Fusarium spp.	C	24
Gloeosporium sp.	N, SD	26

	Reported In The Following States During 1976 [1]	Page
Hackberry decline	N	26
Herbicide tests	C	4, 24
Hypoxylon spp.	C	16
Limber pine dwarf mistletoe	C, W	14
Lodgepole pine dwarf mistletoe	C, W	14
Lodgepole pine tumor	W	5, 25
Mycorrhizae	C	4, 26
Oak wilt	K, N	4, 17
Pinyon dwarf mistletoe	C	15
Pisolithus tinctorius (Pers.) Coker & Couch	C	26
Phomopsis blight	SD	25
Phomopsis juniperovora Hahn	SD	25
Phytophthora citricola	SD	26
Ponderosa pine dwarf mistletoe	C	14
Rhabdocline needlecast	W	26
Rhabdocline pseudotsugae Syd.	W	26
Seedling diseases	C, N, SD	4, 24
Shoestring root rot	C	4, 24
Siberian elm canker	SD	16
Suillus granulatus (L. ex Fr.) O. Kuntze	C	26
Thyronectria austro-americana (Speg.) Seeler	C	16
Thyronectria canker	C	16
Tip blight	N	4, 15
Tumors	W	5, 25
Verticicladiella wagenerii Kend.	C	22
Verticillium wilt	N	26
Weather damage	C, N, W	4, 23
Weeds	C	24
Western gall rust	N, SD	17, 25

[1] C - Colorado
K - Kansas
N - Nebraska
SD - South Dakota
W - Wyoming

DISTRIBUTION OF SELECTED FOREST INSECTS AND DISEASES IN REGION 2 — 1976

LEGEND

- Mountain Pine Beetle (Ponderosa Pine)
- Mountain Pine Beetle (Lodgepole Pine)
- Western Spruce Budworm
- Zimmerman Pine Moth
- Sawfly (Ponderosa Pine)
- Thyronectria Canker
- Diplodia Tip Blight
- Oak Wilt
- Hackberry Decline
- Armillariella Mellea on Pinyon Pine

County Lines
State Lines

National Forests and National Grasslands

Scale in Miles: 25 0 25 50 75 100

WYOMING
SO. DAKOTA
NEBRASKA
COLORADO
KANSAS

Cody, Sheridan, Deadwood, Rapid City, Pierre, Watertown, Mitchell, Sioux Falls, Sioux City, Omaha, Lincoln, Grand Island, North Platte, Casper, Chadron, Alliance, Scottsbluff, Rawlins, Rock Springs, Laramie, Cheyenne, Fort Collins, Steamboat Springs, Glenwood Springs, Grand Junction, Delta, Gunnison, Durango, Monte Vista, Denver, Colorado Springs, Pueblo, Lamar, Dodge City, Wichita, Salina, Topeka, Kansas City

BIGHORN N. F. · THUNDER BASIN NATIONAL GRASSLAND · BLACK HILLS N. F. · SHOSHONE NATIONAL FOREST · MEDICINE BOW N. F. · OGLALA N. G. · NEBRASKA N. F. · SAMUEL R McKELVIE N. F. · FT. PIERRE N. G. · BUFFALO GAP N. G. · PAWNEE N. G. · ROOSEVELT NATIONAL FOREST · ROUTT NATIONAL FOREST · ARAPAHO N. F. · WHITE RIVER NATIONAL FOREST · GRAND MESA N. F. · PIKE N. F. · SAN ISABEL N. F. · UNCOMPAHGRE NATIONAL FOREST · RIO GRANDE NATIONAL FOREST · SAN JUAN NATIONAL FOREST · COMANCHE NATIONAL GRASSLAND · CIMARRON N. G.

DISTRIBUTION OF DUTCH ELM DISEASE 1976

ROCKY MOUNTAIN REGION

LEGEND

County Lines
State Lines

National Forests and National Grasslands

Scale in Miles

WYOMING
COLORADO
NEBRASKA
SO. DAKOTA
KANSAS

Cheyenne
Laramie
Rawlins
Rock Springs
Casper
Sheridan
Cody
Lander
Riverton
Worland
Basin
Greybull
Thermopolis
Powell
Lovell
Deadwood
Rapid City
Pierre
FT. PIERRE N. G.
Watertown
Mitchell
Sioux Falls
Sioux City
Omaha
Lincoln
Grand Island
North Platte
Scottsbluff
Alliance
Chadron
Denver
Fort Collins
Steamboat Springs
Glenwood Springs
Grand Junction
Durango
Monte Vista
Colorado Springs
Pueblo
Lamar
Dodge City
Garden City
Liberal
Wichita
Salina
Topeka
Kansas City
Goodland
Hays
McCook
Norton
Concordia
Beloit
Clay Center
Manhattan
Junction City
Abilene
Hutchinson
Great Bend
Larned
Dodge City
Garden City
Liberal
Scott City
Oakley
Colby
Atwood
Oberlin
Phillipsburg
Smith Center
Osborne
Russell
Ellsworth
Salina
Abilene
Junction City
Manhattan
Clay Center
Beloit
Concordia
Norton
Phillipsburg
Smith Center
Osborne
Russell
Ellsworth
Hutchinson
Great Bend
Larned
Scott City
Oakley
Colby
Atwood
Oberlin
Goodland
Hays
McCook
Topeka
Kansas City
Wichita